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K-2 Grade-Age Children and Their Parents' Experiences Engaging in Engineering and Computational Thinking Activities in Informal Learning Setting (Fundamental Research)

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Abstract

This research study explores children and their parents' experiences engaging in engineering and computational thinking activities in an informal learning environment. The participants in this study comprised eleven families, including K-2nd grade-aged children and their parents, who were purposively selected for this qualitative study. The findings revealed that many children initially hesitated to describe engineering and CT, but when probed, they explained that engineering and CT activities required them to build and/or code. Children also pointed out that these activities were like ones they had done in school. In contrast, parents described engineering and CT activities as requiring thinking and decision-making. Furthermore, some parents equated CT with coding and engineering with building, while others compared computing and engineering to other school subjects, such as math, science, and literacy.

Introduction

As the engineering education community continues to work to broaden participation in engineering, we need to recognize the critical role parents play in children's education and career decisions [1]; [2]; [3]. Parental influence starts at birth, and children's interest in STEM development can begin before elementary school. It is heavily influenced by parents and the environment surrounding the child [4], mainly since children spend most of their waking hours in out-of-school settings [5]. Additionally, exposure to engineering through toys at a young age can impact children's interest in STEM [6]; [7]. While studies of school-based engineering learning are also critical, parents typically have a much more advanced understanding of their children than teachers [4]. Parents can help promote children's in-school learning by exposing them to related activities in out-of-school settings [8]. Therefore, to understand how children might learn and engage in engineering, it is important that we consider parent-supported learning experiences as examples of how we might support children in engaging in engineering.

In addition to engineering, we also consider children's experiences with computational thinking (CT) as CT skills are essential for engineers in the 21st century. CT skills are also helpful for children, especially as there is an overlap between CT and programming, engineering, mathematics, and even language arts.

Background & Literature Review

Computational Thinking

Computational thinking (CT) has become one of the fundamental competencies in the current era of integrated science, technology, engineering, and mathematics (STEM) in pre-college education [9]; [10]. CT is also an essential requirement for future engineers since these skills are necessary for solving complex technological problems for all engineering professionals [11]; [12]. CT, as defined by Wing [13], is "solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science" [p. 9]. CT has become a core competency for the 21st century. In essence, CT integration in pre-college education has been promoted by stakeholders, policymakers, and educators across formal and informal settings [14]; [15]; [16]. Research suggests that the integration of CT offers an encompassing approach that exposes children to computing principles in the context of their learning discipline [13]; [17]. As such, CT can be seen as a bridge that connects computer science to multiple disciplines, including engineering [9]; [18].

Computational thinking and engineering are defined as problem-solving processes [13]; [19]. CT is more than coding and/or programming, but rather a way of thinking when solving complex problems across disciplines [13]. CT draws upon concepts fundamental to computer science, such as abstractions, algorithms, decomposition, logical thinking, and simulation. However, like engineering, CT relies on mathematics as the foundational knowledge to manipulate abstract structures using abstract methods [13]; [15]. Wing posited that CT and engineering are connected and empower each other [13]; [15]; [20]. Cunningham [15] described engineering as the focus of CT in pre-college engineering education. The similarities between CT and engineering make engineering a productive disciplinary context to engage children in CT in both formal and informal settings [13]; [21]; [20]. Thus, examining children and parents' experiences engaging in CT and engineering activities in informal learning is imperative. Parents play a critical role in children's learning and development, so it is also essential to understand how parents engage with their children in CT and engineering activities.

Informal Learning Environments

Informal learning environments can play an essential role in promoting CT and engineering learning [20]; [22]; [23]. Several aspects of informal learning environments foster 21st-century skills such as communication, social skills, collaboration, creativity, technological literacy, and leadership [24]. Informal learning occurs in various settings (e.g., museums, homes, and everyday activities). It is characterized as social, playful, and engaging in ways that foster children's natural tendencies to explore, ask questions, experiment, and design [24]. Such learning environments offer opportunities for children to extend learning beyond the classroom by providing rich experiences that can also cultivate their 21st-century skills [23]; [24]. Informal learning environments can be categorized into three major settings: everyday experiences, designed settings, and programmed settings [5]. Informal learning environments can support children's interest, engagement, and understanding through self-directed learning experiences [25]. Moreover, informal learning experiences that focus on developing children's knowledge, skills, and positive attitudes can also impact children's development [26]; [27]. As Vela et al. [4] assert, informal settings can act as a "catalyst for students to become interested in STEM-related fields and motivate them to pursue STEM-related careers" [p. 105].

In pre-college education, studies have explored children's engagement in CT and engineering in informal settings [20]; [28; [29]. Consistent with the global movement referred to as "Informal Computer Science Education" [16]; [22]; [23], recent work has focused on introducing CT in a variety of informal settings via toys and media that children might encounter in everyday settings, in designed spaces such as science centers, and through outreach programs that target school-aged children. Most of these outreach programs aimed to expose children to out-of-school CT-related activities or supplement what children already experience in schools [30]. Ehsan et al. [20] investigated CT of early childhood children in the context of family-based engineering design activities. They found that children could engage in several CT competencies (abstraction, pattern recognition, problem decomposition, etc.) in the context of an engineering activity. Similarly, in another study, Ehsan et al. [2] investigated a parent's role in promoting CT in her homeschooled six-year-old child. The authors found that the parent supported her child's understanding and played multiple roles (e.g., facilitation, co-learning, encouragement). These studies highlight the importance of informal learning environments, as such environments can provide children with opportunities to connect with learning (Vela et al., 2020). Most importantly, these studies illustrate the parental influence on early childhood children's learning and development [2]; [20].

This research is theoretically grounded in social constructivist views of learning, where learning occurs via interaction in social and cultural settings [31]. The social learning environment in this study is the science center, where children and their parents engage in CT and engineering activities.

Theoretical Framework: Social Constructivism

Social constructivism is a learning theory that posits that individuals actively create knowledge due to social interactions and language use and is, therefore, a shared experience rather than an individual [31]; [32]. Hence, learning is an active process where learners should learn to discover principles and concepts themselves through collaboration and interactions within their environment [32]. Moreover, Vygotsky [31] claimed that learning is a continual movement from the current intellectual level to a higher level which more closely approximates the learner's potential. This movement occurs in the zone of proximal development (ZPD) due to social interaction. The zone of proximal development (ZPD) has been defined as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers" [31, p. 86].

Play and unstructured, informal activities stimulate children's social interaction and influence their learning and knowledge construction [31]. These learning environments also promote social constructivist views of teaching and learning [33], where learning occurs collaboratively in small groups. In such informal settings, assistance from a more knowledgeable other, the parent or a competent peer, helps children achieve their potential stage of development. Burner [34] referred to this guidance as *scaffolding*. During an informal activity, parents can support their children's learning and understanding through scaffolding, collaboration, and language sharing. Therefore, parental influence is critical in child development and education as they are their children's first teachers [3].

Research Purpose & Questions

Parents play a vital role in early childhood experiences. With engineering and CT amalgamated in pre-college formal and informal education, exploring parents' and children's experiences is imperative. Thus, this study explores kindergarten through second-grade children and parents' experiences regarding engineering and CT after engaging in informal engineering and CT activities at a local science center. The research question addressed in this study is: *How do parents and children describe their experiences engaging in CT and Engineering activities?*

Methods

Research Design

A descriptive qualitative study was employed [35] to investigate how children and parents perceived CT and engineering based on their experiences. Qualitative descriptive studies draw from the general tenets of naturalistic inquiry, which allows investigations of a phenomenon in its natural state. This methodology fits studies "when straight descriptions of phenomena are desired" [35, p. 339]. The target phenomenon in this study is children's and parents' perceptions of engineering and CT after they experience engineering and CT activities in a local science center.

Participants and Settings

The participants included 11 families purposively selected since they all participated in CT and engineering activities at a small science center. These families were contacted after their children experienced the STEM+C+ Literacy curriculum in their respective classrooms [20]; [36]. Additionally, both children and parents agreed to be interviewed after participating in the activities at the science center. The demographics and grade levels of the participants are presented in Table 1. To protect the privacy of the participants, pseudonyms have been assigned.

Table 1.

Children and Parents' Demographic Information

Participants	Family Members	Age (Parent + Child)	Race/Ethnicity
Family 1	Mother & Daughter	35-39; 5 years	White
Family 2	Mother & Son	35-39; 6 years	White
Family 3	Father & Daughter	30-34; 5 years	White
Family 4	Mother & Son	25-29; 6 years	Black/African American
Family 5	Mother & Son	30-34; 6 years	White
Family 6	Father & Daughter	35-39; 7 years	White
Family 7	Mother & Son	35-39; 6 years	Multiracial
Family 8	Father & Daughter	45-49; 5 years	White
Family 9	Father & Daughter	50-54; 6 years	White
Family 10	Mother & Son	35-39; 7 years	White
Family 11	Father & Son	30-34; 7 years	White

The study occurred at a small science center in the Midwest. Children (K-2^{nd} aged) and their parents engaged in an exhibit entitled "Computing for the Critters." After their engagement, children and parents were interviewed separately.

Context: Computing for the Critters Exhibit

"Computing for the Critters" was an exhibit designed for a larger STEM+CT project that included school-based activities, at-home activities, and activities at a small science center and the exhibit [28]. The exhibit was designed to engage preschool through elementary school-aged children in designing ways to deliver medicine to sick pets. Children had several ways to deliver and test their ideas, including in the playscape (Figure 1) or by writing an algorithm to program a digital robot (Figure 2).

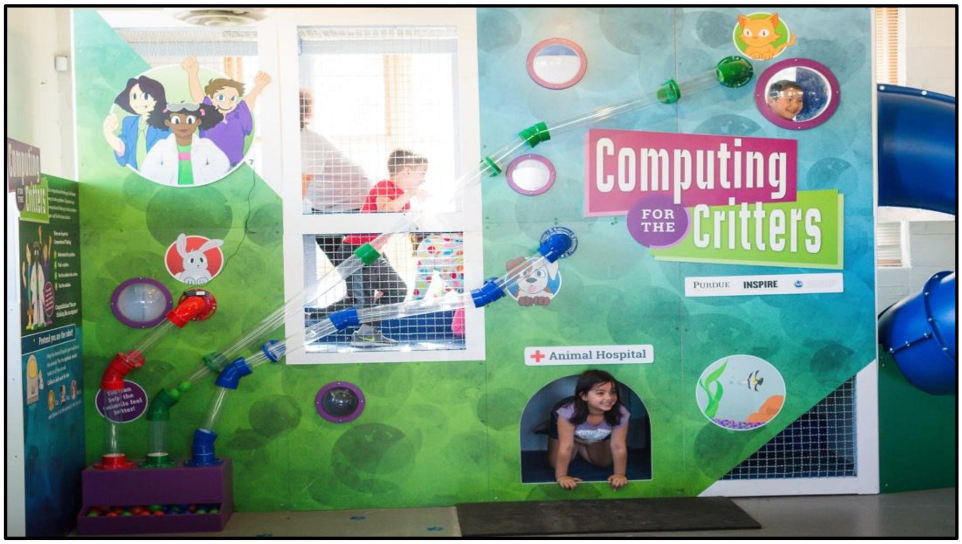

Figure 1: Computing for the Critters Playscape (Previously published in Ehsan et al., 2023)

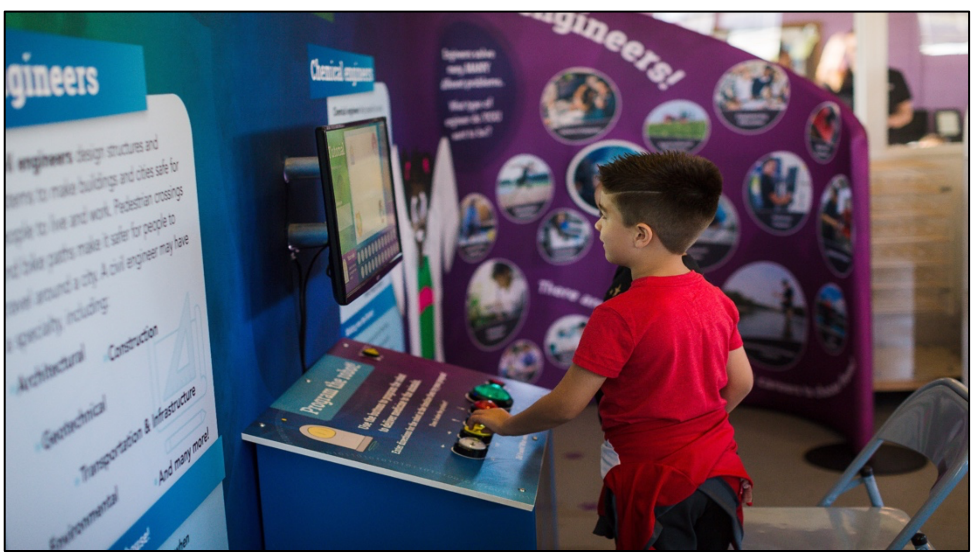

Figure 2: Computing for the Critters Coding Game (Previously published in Ehsan et al., 2023)

Data Source

The data sources for this study consisted of children and parents' semi-structured interviews and video recordings of the children and parents' interactions, including conversations as they engaged in the exhibit activities [35]. Following their engagement with the exhibit, children and parents were interviewed by a research team member. The different interviews were conducted by different research team members based on researcher availability. In the interviews, we asked children and parents *what* and *how questions* regarding their experiences in the CT and engineering activity and their prior experiences with similar CT and engineering activities [35]; [37]. While the interview transcripts were the primary data source we used in this analysis, we also used video recordings of their engagement in the CT and engineering activities in the exhibit to capture any possible conversation that highlighted individuals' perceptions towards CT and engineering.

Data Analysis

We used thematic analysis to analyze the interviews and video transcripts since it allows for a systematic way of seeing and processing qualitative data [38]. We followed Braun and Clarke [38]'s six-phase method for thematic analysis, which encompassed *familiarizing yourself with data*, *generating initial codes, searching for themes, reviewing, defining, and naming the themes, and creating the report.* First, statements in the interview were coded with descriptive labels through emergent coding, and these codes were categorized into themes. Constant comparison, first within each interview and then within each group (i.e., children as a group and parents as a group), was used to continually sort the data until a robust set of themes explaining the data was developed for each group. Then, video recordings that captured all the moments of target participants' conversations and interactions relevant to CT and engineering were reviewed. The transcriptions of these moments underwent a similar process of thematic analysis by both the first and second authors and were shared with the third author.

The study is strengthened through triangulation. Triangulation included data and researchers. Data consisted of transcription of children's and parents' interviews along with video recordings of the parent and children interaction. Multiple researchers coded the data individually, then re-coded it as a group to develop themes. Disagreements were discussed until all the researchers agreed [39]. The following abbreviated identifiers are used when quoting from the data: 'C#" for child identification and 'P#' for parent identification.

Findings

The findings of this study revealed that many children initially hesitated to describe CT and engineering. However, when probed, children explained that CT and engineering activities required them to 1) build and/or code and 2) these activities were like ones they had done in school.

Children' Experiences

CT and engineering require coding and/or building

Children pointed out that CT activities are computer games or simulations requiring them to code. Children associated with CT through their experiences playing with the exhibit activities and other coding-based toys and games. For example, some children linked their past with present CT experiences, "we had to guide the robotic mouse to the cheese, and we helped Peri with hamsters. We had to make a code to guide the robotic mouse to the cheese at school" (C6). Another student also stated, "We had to guide the robot mouse to the cheese. We had to code to guide the mouse. It was a toy mouse" (C1). The "robot mouse" activity children referenced in these quotes was an activity that children engaged in their respective classrooms as part of the STEM+ C + literacy curriculum.

In contrast, children also compared their engagement in the exhibit activities with activities they experienced at home and/or in other informal settings. For instance, one child claimed, "Bop-It. It is kind of like that [exhibit coding activity], a little bit. You have to follow the directions that the Bop-it says, and it counts how many things you do" (C5). In this case, the child compared the exhibit coding activity experience with a game the child may have been exposed to at home.

Many children explained that engineering activities required them to build. They associated engineering with physically creating something and/or a person that creates something. For example, a child stated, "Engineering is someone that builds stuff" (C2). Another pointed out, "They can help people build stuff [using] special parts, springs, and metal" (C5). Similarly, another child described engineering as fixing, as the child claimed, "fix things. They have to test it before they sell them, I guess" (C11). In these cases, children explained their engineering experiences by connecting them to an activity that requires building or a person that fixes things. None of the children in these cases referenced any specific engineering activity they participated in during the exhibit experience.

CT and engineering are similar to ones done in school

Children expressed that CT activities that they engaged in the exhibit were like those done in school, which required them to use a computer to complete the activity. For example, one child discussed an assessment tool they utilized in schools that required them to use a computer to complete the assessment, "I think of [a] training tool, like Starfall" (C6). Another child referencing a computer stated, "I learned how to use it. I like to take quizzes on it" (C5). In these descriptions, it is evident that children compared the coding game they engaged in, which required them to use a digital device, to other devices they have used in school. They had difficulty expressing their CT experiences, which was unsurprising given their age. While some perceived CT as a computer utilized at school for assessments, others referred to CT as a computer game.

Children described engineering activities similar to ones they had done in school. Many children linked engineering activities they participated in the exhibit with activities that were part of the STEM+C+literacy curriculum in which children solved a problem. For example, one child asserted, "We are learning all about engineering. We helped Max and Lola make a basket so other people can pick their rocks" (C1). In another instance, a child claimed, "[we had] to design a toy box so it won't get messy" (C7). Another child stated, "It is like when you work together and do science and explore stuff" (C3). These cases illustrate that children made connections to the exhibit activities (design a way to deliver medicine to sick pets), which they expressed were similar to the ones they engaged in at school.

Parents' Experiences

Parents described CT and engineering activities as activities that required thinking and decision-making. Furthermore, some parents equated CT with coding and engineering with building, while others compared CT and engineering to other school subjects, such as math, science, and literacy.

CT and engineering require thinking and decision-making.

Parents expressed that many of the CT activities in the exhibit they engaged in with their children required them to think and make decisions. For example, a parent asserted, "It is logical thinking" (P2). This parent further suggested, "You have to start from the beginning with an end in mind. It requires step-by-step thinking" (P2). Another parent claimed, "It is like solving complex problems" (P3), connecting it to the exhibit activities where they had to figure out the most effective way to deliver medicine to the animals. Likewise, another coupled CT activities with problem-solving and decision-making, the parent stated, "I think of it as problem-solving, like different pieces to the puzzle. It is something you do in any decision you make daily effortlessly" (P6). In these examples, parents linked their experience of working through the CT activities with their children to solving problems or completing tasks that required thinking.

Parents equated engineering activities with activities that required thinking and decision-making. One parent asserted, "I think engineering tasks are thinking creatively about how to make things. Putting things together in different ways and different combinations" (P2), making connections with the engineering playscape activity in which children had to find the most effective way to deliver medicine to the animals. Also, another parent claimed, "I think engineering is a way to solve problems similar to the activity" (P5). When describing engineering, the parent references some of the activities their child engaged in, such as the playscape activity. Furthermore, one parent initially hesitated to share their experiences and perceptions of engineering but, when probed, claimed, "It is a difficult question because everyone has their understanding and experiences with [engineering]. Engineering, to me, is like a thought process on how to do something and execute it based on trial and error. Like if something doesn't work" (P4). These descriptions connect to the experiences parents shared with their children as they engaged in the CT and engineering activities at the science center.

CT and engineering require coding and/or building

Most parents suggested that CT engagement requires a machine used for coding. "CT/Computing is using the computer and building using coding or computer language something that's going to give you what you need to accomplish a certain task" (P3). While another parent expanded upon this proposing that CT activities are coding, using a machine that assists with functionality. The parent stated, "We have machines today to figure all that out with coding to help function, like we do today" (P2). Similarly, another parent expressed CT as a computer used for coding, "It is for coding" (P11). Parents in each of these cases associated CT activities with a computer utilized to complete a task (e.g., programming or coding), emphasizing that CT occurs via a machine like one of the activities in the exhibit in which children had to write an algorithm to deliver medicine to the animals effectively.

Many parents expressed that engineering requires building, and/or engineers are tasked with building and/or fixing things. For instance, a parent noted, “I feel like engineering is the brains behind building something. The engineering of something is to create it” (P6). Likewise, another also linked engineering to creating, stating, I guess it all has to do with building or designing whether it’s at a molecular level, or whether you’re talking about dams, bridges, and buildings or things like that” (P3). The parent elaborated and shared that he read the descriptions of the different types of engineering (e.g., civil, chemical, mechanical, etc.) that were a part of the exhibit but felt that building is something that different engineering fields have in common. Another parent explained that engineers build but follow a process similar to their child's experience in the engineering activities and the curriculum in their respective classrooms. The parent asserts, “Engineers try to build something. What we learned here (exhibit) and through the curriculum is that you go through different phases of planning and designing. Then you go back to the drawing board and test until you come up with the right answer to whatever it is you are trying to build or design" (P11). As noted earlier, connecting engineering and/or engineering activities to building was a common phenomenon that parents shared as a result of their and their children’s experiences.

CT and engineering are similar to other subjects

Some parents also compared the CT activities they experienced with other subjects or domains taught in schools. For instance, one parent stated that CT is “like in math you have to do computing in a calculator or your head” [sic] (P11). The parent further asserts, “Also with what she was doing like coding. She is having to think through a series of steps to get the robot to each of the animals” (P11). In this instance, the parent connected their child's experience writing an algorithm in the exhibit activity to a subject (math) in which a device is used for calculation (e.g., calculator). Likewise, another parent stated that CT is similar to math, “I would have considered it was mathematical, and that is something that I would have attributed to what we did today [referencing the exhibit activities], but stepping back and really thinking about it, that's exactly what it is. It is probability” (P6). In contrast, reflecting on what they and their child experienced, the parent asserted, “I feel like it's kind of engineering on a smaller scale, figuring out what different buttons do to make something happen on a screen. Or a different combination of buttons to make it do something different” (P5). When describing their experiences, many parents referred back to the CT activities that were part of the exhibit and then related them to things they were most familiar with, such as using a calculator for math.

Engineering activities parents experienced with their children were compared to other subjects like math, science, and literacy. As parents reflected on their experiences, they were quick to point out that engineering is the application of content. Thus, knowledge of math, science, and /or literacy is essential for engagement in engineering. For instance, a parent noted, “The application of physics. Physics is a theory, and engineering is the application of that, and it is being complemented with computing” (P7). Another parent asserted, “Well, there are different types of engineering. But it is part science and part math. You are putting the two together and [using] it for problem-solving (P1). Moreover, one parent claimed, “It is a science that allows you to invest and create” (P6). These examples illustrate that parents’ prior experiences may have contributed to how they viewed or engaged with engineering. It is important to note that these descriptions may have also resulted from what their children experienced and shared from school as part of the STEM+C+literacy curriculum [40].

Discussion

Parents play an imperative role in their child's education [3]; [33]; [41]. Thus, after engaging in informal engineering and CT activities, exploring children's and their parent's experiences with CT and engineering is pertinent. The results of this study contribute to children's and parents' CT and engineering knowledge base by examining their experiences. Several findings are clear.

First, this study illustrated commonalities between children and parents and how they experienced CT and engineering activities. Children and their parents suggested that CT and engineering activities required them to code and/or build. Children discussed coding/building due to their experience engaging in activities at the science center and STEM+C+literacy curriculum in their classroom. Likewise, parents also asserted that CT and engineering activities required coding/building. However, parents associated coding with a computer device used for programming and building with a job requirement of all engineers. The cohesion between children and parents' description of their shared experiences highlights the role parents play in their child's education [2]; [3]; [33]; [41]. This finding supports previous research that has found that parental involvement is strongly associated with children's cognitive and non-cognitive outcomes [42]; [43]; [44]; [45]. Fan and Chen [1] posited that parental involvement is essential for solutions to many problems in education and positively affects students' academic achievement.

Secondly, the findings revealed that children compared CT and engineering activities to other things in school, such as using a computer to take assessments and solving a problem by creating as part of the STEM+C+literacy curriculum. In contrast, parents equated CT and engineering activities with other school subjects, such as math, science, and literacy. It is possible that as a result of children's engagement in the coding exhibit activity, in which they used a computer to write an algorithm to help deliver medicine to the animals, children compared that with using computers at school to complete assignments. Parents' experiences with CT and engineering are consistent with literature suggesting that CT and engineering should be integrated with other disciplines [15]; [21]. As Yadav et al. [46] indicate, using CT vocabulary across the curriculum can reinforce students' understanding of the terms and help students see their applicability across the curriculum and in daily life. Hence, it is vital to develop parents' knowledge of CT and engineering and its core components if it is to be infused early into children's education [47].

Furthermore, parents described that CT and engineering activities required thinking and decision-making. The video data also showed their interaction with their children in the exhibit activities where children had to think before solving the problem. This notion that CT and engineering are problem-solving processes complements how CT and engineering have been conceptualized in the literature [13]; [15]; [48]. Moore et al. [49] suggest that "general problem-solving skills are prerequisites to solving engineering problems [p. 5]. Problem-solving skills are critical for all engineers and equally significant for all other professional disciplines [50]. Parents' recognition that CT and engineering activities require thinking and decision-making is also important as a contrast to seeing engineering and computational thinking as just building or interacting with a computer. We used social constructivism as the theoretical foundation for this study, and see this focus on thinking, decision-making, and problem-solving as a specific element of the Zone of Proximal Development for the children in this study. Children and their parents suggested that CT and engineering activities required them to code and/or build, but parents *also saw* engineering and computational thinking as activities requiring thinking and decision-making, and thus are positioned to scaffold learning experiences to allow their children to adopt this more expansive sense of what engineering and CT are.

Limitation

The findings of these studies are based on children's and parents' descriptions of their experiences engaging in CT and engineering activities at a local science center and our observations of their engagement in those activities. All the participants were purposively selected since their children engaged in STEM+C+literacy in their classrooms. Future studies should attempt to include more diverse populations to capture a broader set of perspectives. Additionally, the data in this paper were based on children's and parents' experiences that may have developed due to the exhibit. Future studies that capture children's and parent's perspectives of CT and engineering before any engagement in CT and engineering-focused activities would allow us to understand better parents and children's initial perceptions of CT.

Children in this study had experienced CT and engineering in their respective classrooms via the STEM+C+literacy curriculum prior to engaging in the exhibit activities. These experiences (formal + informal) may have contributed to children's description of CT and engineering. As highlighted in the results, many children referenced these experiences when describing CT and engineering activities. However, that was not the case for parents. It was difficult to determine based on parents' descriptions, what experiences parents may have had associated with CT and engineering before their engagement in the exhibit activities. Hence, future studies, need to examine parents' prior experiences (educational and/or professional background) to understand how parents' role may have impacted children's experiences.

Conclusion & Implication

Parents play multiple roles in their child's learning and development [1]; [2]; [3]. Parental involvement in their child's education is imperative during their early school years [1]; [3], as during this time, children begin to develop their perceptions [51]. The findings demonstrate that while children initially hesitated to describe CT and engineering, when further queried, they were able to explain that engineering and CT activities required them to build and/or code. Children also pointed out that these activities were like ones they had done in school.

Parents described engineering and CT activities as requiring thinking and decision-making. Furthermore, some parents equated CT with coding and engineering with building, while others compared computing and engineering to other school subjects, such as math, science, and literacy. Given parents' roles in supporting children's learning, it is important to consider what they understand engineering and CT to be. This can allow future research to investigate how we might enable parents and other adults to develop their understanding of engineering and computing further. For example, we might develop workshops that build on parents' current understandings (as well as their everyday practices) to allow parents to notice ways that they are practicing engineering and CT in their current family practices. Or we might develop resources that celebrate families' everyday engineering and CT practices that similarly allow parents and other adults to make connections between daily activities and engineering and CT. The findings from this study provide researchers and educators an insight into children's and parents' thinking about CT and engineering. A clearer understanding of young children's perceptions of CT and engineering has implications for the academic community. Once we know what perceptions children may possess, experience, programs, and parent resources can be created to expand how children and adults think about CT and engineering.

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